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Development of novel PDMS elastomers for dielectric electroactive polymers (DEAPs)

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Dielectric electroactive polymers (DEAPs) are polymeric network systems that can be used to convert an electrical input to mechanical deformation of a polymer. DEAPs can be applied as actuators, sensors and generators due to their ability to exhibit a change in size and shape when an external voltage is applied as well as generate electrical energy when the material is exposed to mechanically induced deformations. DEAPs are normally constructed from thin filled elastomer films sandwiched between two compliant electrodes. The working principle of a DEAP actuator can be seen in Figure 1.

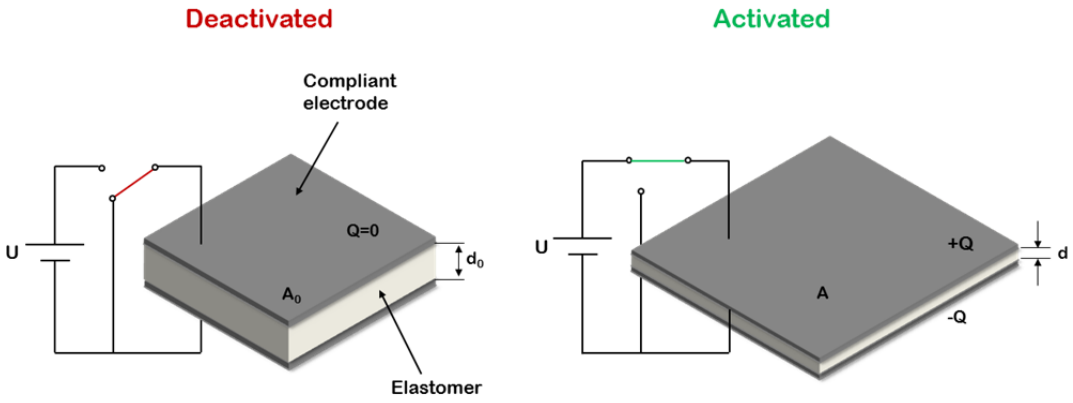

Figure 1: DEAP actuator working principle. When a high DC voltage is applied to the electrodes, the electrostatic pressure squeezes the elastomer film in thickness and the film is expanded in planar directions. When the external voltage is switched off, the elastomer film returns to its original shape.

Polydimethylsiloxane (PDMS) is one of the most used materials for DEAP applications due to its good thermal stability, high efficiency and fast response. This work presents new functional PDMS materials for DEAP applications with increased dielectric permittivity. The permittivity is enhanced by grafting of functionalities such as dipoles to a novel silicone compatible cross-linker. Incorporation of functionality at the cross-linking point allows for controlled and well distributed modification of the PDMS network. Even very small loadings, e.g. 0.5 wt%, of incorporated dipoles have led to a large increase in the dielectric permittivity.